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ABSTRACT. The last two decades have been a period of structural change in industrialised countries. The extent of this restructuring process has been different across countries and industries, though. In this paper we investigate the effect of lagging behind in the process of downsizing and deconcentration. We find empirical evidence of industries that experienced only little downsizing when compared internationally to experience less subsequent growth, on average. However, this effect is industry-dependent and its magnitude depends upon whether firm or establishment data are used. Technologically advanced industries are found to be particularly sensitive to (lack of) restructuring.

1. Introduction

In the industrialised countries there has been a tendency for the share of large units in manufacturing to decrease in terms of economic activity. Carlsson (1996), for example, shows that the employment share of the Fortune 500 firms in U.S. manufacturing has decreased from almost 80% in 1975 to 65% in 1990. The reasons for the decline in the share of largeness in manufacturing have been discussed in a series of papers. However, the consequences of this decline have been barely addressed in the literature. This is somewhat surprising as the speed of this industrial restructuring process has been different across countries. In the current paper we investigate how the extent of the shift of economic activity from large to small businesses has affected economic performance. For this purpose we use a data set of 26 manufacturing industries at the 3-digit level for the five largest economies, France, Germany, Japan, the United Kingdom and the United States.

There is substantial evidence that economic activity in manufacturing has been moving away from large firms to small firms in the final quarter of the 20th century. Papers which provide statistical evidence for several countries include Acs and Audretsch (1993), Van Ark and Monnikhof (1996), Carlsson (1996), Loveman and Sengenberger (1991) and OECD (1994). One explanation for the growing small business presence *economy-wide* is the increase of the employment share of the relatively small-scaled service sector at the expense of the relatively large-scaled manufacturing sector. But also in the manufacturing sector itself small entrepreneurial firms have achieved considerable economic successes in a period during which many well-known large corporations suffered heavy losses. Various authors have contributed to our understanding of the reasons behind this change in the size class structure of industries. Loveman and Sengenberger (1991) mention two important trends of industrial restructuring: that of decentralisation and vertical disintegration of large companies (returning to core activities) and that of the formation of new business communities. In addition, they argue that there has been an increasing role of public and private policies promoting the small business sector (e.g. venture capital). Piore and Sabel (1984) consider industrialised countries to be in what they call the Second Industrial Divide and claim that it has promoted flexible specialisation making economies of scale less important than beforehand.[1] Flexible specialisation is thought to be beneficial for small firms because they are better equipped to deal with market fragmentation. A collection of other reasons can be found in Brock and Evans (1989). These include the increased demand for variety leading to niche

Final version accepted on May 5, 2001

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Small Business Economics **18**: 243–255, 2002.

markets and the deregulation movement which sweeps the world.

The list of reasons for the process of downscaling in manufacturing industries suggests that the extent of the shift of economic activity from large to small businesses may affect economic performance.[2] Acs (1992, 1996) claims that small firms fulfil an important role in the economy serving as entrepreneurial agents of change, being the source of an important part of innovative activity, stimulating industrial evolution, and creating an important share of the newly generated jobs.[3] The transfer of employment from large to smaller firms has intensified scepticism about superior economic performance of large enterprises and led to "a revival of the ideology of entrepreneurial capitalism" (Lane, 1995, p. 64). The large, vertically integrated and centralised corporations have become associated with undesirable features like excessive bureaucratic control, rigidity, failure of communication and lack of concentration on core activities. The disintegration and deconcentration of such companies in the 1980s implied an increase in the small firm employment share through subcontracting, divestments and buy-outs.[4] The resurgence of small firms does not imply that the large-firm sector fails to contribute to economic development. Large companies *and* small and medium-sized firms have complementary strenghts, see for example the theory of "dynamic complementarity" in the advance of technology (Rothwell, 1983, 1984). In addition, in several industries scale economies in production (e.g. petroleum refineries) or research and development (e.g. pharmaceuticals) leave the "minimum efficient scale" relatively large. The idea is summarised by Lane (1995) as "a balanced size distribution, including also medium-sized enterprises, together with co-operation between large and small firms, is widely seen as a favourable condition of strong economic performance" (p. 119).

In the current analysis we concentrate on the effects of changes in the size distribution of firms and plants. This is only one dimension of structural change. Important other trends of restructuring like economic activity shifting away from low-skill industries to technologically advanced industries, the increased importance of multinationals, trends in the specialisation of countries or the geographic concentration of industries (see e.g. Aiginger et al., 1999) and changes in the extent of diversification (see e.g. Jovanovic, 1993) are not taken into account. However, these other trends are more or less related to changes in the firm-size distribution. For example, the trend towards shifting activity away from manufacturing towards service industries is partly a consequence of manufacturing firms returning to core activities and reducing their workforce involved in service-related activities.

The rest of the paper is organised as follows. In Section 2 we discuss the empirical evidence on the extent of downsizing in manufacturing industries. We also discuss our data set and discuss the variables of restructuring (downsizing) and economic growth. Restructuring is measured as the change in the share of large firms, while economic growth is measured in terms of the growth in value added in constant prices. In Section 3 we present the empirical results of the effect of the extent of restructuring on (subsequent) economic growth. Section 4 concludes.

2. The decreasing share of large firms and large plants

A comparison of the extent of downsizing in terms of the declining share of employment share of large firms across countries shows some striking differences.[5] Lane (1995, p. 73) reports for example that this employment loss has been very pronounced in the United Kingdom, while it has been more moderate in France and only very slight in Germany, during the 1981–1987 period. She shows that similar reductions had been taking place at the enterprise and at the establishment level. Data provided by van Ark and Monnikhof (1996) for the share of enterprises with 500 and more employees as a percentage of total employment in manufacturing confirm this. They show that in the United Kingdom the share dropped from 54.3% to 40.9% in the 1977–1990 period.[6] This decline was from 55.3% to 44.7% for France and from 58.0% to 56.6% for Germany, respectively in the same period.[7] These data indicate that in terms of the share of large firms in employment the German manufacturing sector has failed to restructure during the 1977–1990 period.[8]

The rigorous industrial restructuring may have

given the manufacturing sector in the United Kingdom, on average, a better starting position for the 1990s than its German counterpart. However, there is very little empirical research which supports such a type of assertion. We mention three exceptions. Engelbrecht (1997) found that the organisational "fat" built up in U.S. manufacturing firms in previous years adversely affected U.S. export competitiveness to an important extent during the 1980s. The increased openness to international trade forced U.S. manufacturing firms to cut nonproduction employment. Nickell (1996) and Nickell et al. (1997) presented evidence that competition, as measured by increased number of competitors, has a positive effect on the rate of total factor productivity growth. Carree and Thurik (1998) showed evidence for European manufacturing at the two-digit industry level that a relatively high large firm share in 1990 has had a negative impact on production growth in the 1990–1994 period. This study extends the evidence provided in the study by Carree and Thurik by examining industries at a lower level of aggregation, by investigating industry-specific effects and by including the Japanese and U.S. manufacturing sectors.[9]

In this study we use a data set of five countries, being the largest economies, France, Germany, Japan, the United Kingdom and the United States, and 26 manufacturing industries. As a measure of restructuring we use the change of the employment share of "units" with 500 and more employees during the 1977–1990 period.[10] For France, Germany and the United Kingdom the "units" are enterprises while for Japan and the United States these are establishments (plants). The source of the employment share data is van Ark and Monnikhof (1996). As a measure of economic performance we use the growth of value added (in constant prices) over the 1990–1994 period. The source of these data is the OECD STAN Database (1997). In Table I the industries and their corresponding average value added index (VAI) in constant prices (VAI = Value added 1994/Value added 1990) are displayed. Furthermore, it shows the corresponding averages and standard deviations of the large firm employment share (LFES) for France, Germany and the United Kingdom for 1990. In the appendix the same data are shown for 1977[11] and for the average and standard deviation of the large plant employment share for Japan and the United States, both in 1977 and 1990.

Table I shows that the *electrical machinery* industry (ISIC 383) had the strongest increase of value added on average for the five countries. The average rise in value added was 17.9%. The largest decline on average was found for the *footwear* industry (ISIC 324). The average decline was 24.5%. These figures are an indication of the shift from low-tech to high-tech industries which is taking place in developed countries.[12]

In the second column of Table I we see that the industries with smallest scale of production are the "low-tech" industries of *wearing apparel* (ISIC 322), *leather products* (ISIC 323), *wood products* (ISIC 331), *furniture and fixtures* (ISIC 332) and *printing and publishing* (ISIC 342). In the last column of Table I the standard deviation of the employment share of firms with 500 or more employees is presented. The industry structure appears to be very different between the three European economies in the industries of *food products* (ISIC 311/2), *beverages* (ISIC 313), *rubber products* (ISIC 355) and *machinery, nec (incl. computers)* (ISIC 382). Out of 26 industries there are 22 in which the standard deviation increased between 1977 and 1990. The main reason for this is the lack of restructuring in Germany. In 1977 the average LFES in France, Germany and the United Kingdom were 0.493, 0.512 and 0.511. In 1990 these values were changed to 0.415, 0.492 and 0.416. That is, whereas in 1977 the share of large firms, on average, in manufacturing industries was about equal in the three countries, in 1990 Germany had a clearly larger share than France and the United Kingdom.[13]

Comparing industry structure across countries poses several problems. One such problem is that the unit of analysis is defined differently across countries. The unit of analysis is the "enterprise" in case of the European countries. The "enterprise" is a legal entity representing common ownership or control as recognised in national legislation.[14] In case of Japan and the United States the unit of analysis is the "establishment", which is characterised by its single physical location where industrial production or services are executed. Because of this difference in the unit of analysis we concentrate on comparing the three European

TABLE I
Growth and restructuring in 26 manufacturing industries

ISIC	Industry	Average VAI	Av. LFES	Std. LFES
311/2	Food products	1.001	0.396	0.152
313	Beverages	1.010	0.435	0.174
321	Textiles	0.934	0.302	0.089
322	Wearing apparel	0.849	0.204	0.120
323	Leather products	0.777	0.076	0.045
324	Footwear	0.755	0.398	0.089
331	Wood products	0.979	0.093	0.039
332	Furniture and fixtures	0.963	0.160	0.099
341	Paper products and pulp	0.994	0.315	0.058
342	Printing and publishing	0.968	0.185	0.061
351	Industrial chemicals	1.050	0.670	0.126
352	Other chemicals (including drugs)	1.120	0.660	0.114
353	Petroleum refineries	1.070	0.819	0.031
355	Rubber products	0.929	0.706	0.158
356	Plastic products, nec	1.098	0.230	0.093
361	Pottery, china, etc	0.936	0.568	0.114
362	Glass products	1.001	0.617	0.043
369	Non-metal products, nec	0.999	0.282	0.091
371	Iron and steel	0.974	0.699	0.104
372	Non-ferrous metals	0.932	0.426	0.112
381	Metal products	0.977	0.207	0.107
382	Machinery nec (including computers)	0.921	0.355	0.153
383	Electrical machinery	1.179	0.626	0.106
3843	Motor vehicles	1.000	0.818	0.112
3845	Aircraft	0.850	0.896	0.036
385	Professional goods	0.897	0.324	0.091

Note: VAI stands for "value added index" and equals the ratio of the industry value added in 1994 and that in 1990, both in local currencies and constant prices. LFES stands for the "large firm employment share", which is the employment share of enterprises for France, Germany and the United Kingdom with 500 or more employees. The last two columns of the table contain the average and standard deviation of LFES for 1990.

countries and comparing Japan with the United States.[15] There are differences not only with respect to the unit of analysis, but also the extent of dependency of small firms on large firms may differ. The Japanese industrial subcontracting system, for example, has strong ties between firms within an industrial group, the *keiretsu* (McMillan, 1996). For these reasons we should be cautious when comparing the structural developments across countries.[16]

Our measure of the rate of restructuring is the change in the employment share of units with 500 or more employees in the period 1977–1990. For the three European countries the unit is the firm. For Japan and the United States the unit is the establishment. In Table II we show the average and the standard deviation of the change of the employment share of large units. The averages show that the U.K. manufacturing sector and the German counterpart were polar cases. In the United Kingdom the drop in the share of large firms was relatively strong, while in Germany it was only limited. The standard deviation of the change across the 26 industries ranges from 0.055 for France to 0.081 for the United Kingdom. Neither in the case of the average growth of the large unit employment share nor the standard deviation of this variable, we find that the three countries with "enterprise" data form a group that differs strongly from the group of two countries with "establishment" data.

In Table III the correlation matrices of both the change in large unit presence and the growth rate of value added is presented. We find that value added growth is positively correlated across countries. That is, industries that grow more than on

TABLE II
Summary statistics of restructuring and growth

	DLES		*VAI*	
	Mean	St Dev	Mean	St Dev
France	–0.079	0.055	0.964	0.092
Germany	–0.020	0.068	0.928	0.149
Japan	–0.059	0.070	0.934	0.170
United Kingdom	–0.094	0.081	0.961	0.103
United States	–0.053	0.062	1.052	0.164
Total	–0.061	0.071	0.968	0.144

Note: DLES stands for the change in the "large unit employment share". *VAI* stands for the "value added index" with 1990 = 1. In the last row all 130 observations are taken into account.

TABLE III
Correlations of value added index (VAI) and change in large unit presence (DLES)

	France	Germany	Japan	U.K.	U.S.
France		0.55	0.42	0.12	0.34
Germany	–0.04		0.53	0.34	0.51
Japan	0.19	–0.02		0.45	0.35
United Kingdom	0.34	0.26	0.36		0.13
United States	0.14	0.44	0.24	0.16	

Note: The correlation coefficients below the diagonal are for the change in the "large unit employment share" (DLES) while those above the diagonal are for the "value added index" (VAI).

average in one country are also likely to grow more than on average in another country. A high correlation coefficient between the value added growth indices for two countries indicates that structural developments, in the sense of shifts in the industry shares in the manufacturing sector, have been similar for the 1990–94 period. With two exceptions (France-Germany and Germany-Japan) the correlations between the changes in the employment share of large units are positive as well. The average correlation is relatively low at 0.21. It shows that there are large differences between countries in the distribution of the extent of restructuring across industries. In case an industry in one country shows an above average decrease in large unit presence, it is not unlikely for it to show a *less* than average decrease in another country.

3. Regression results

In this section we present the model and discuss the estimation results of the effect of the rate of downsizing at the industry level on (subsequent) economic growth. The effect of restructuring is likely to be industry-dependent with some industries experiencing increased importance of economies of scale and others experiencing increased importance of diseconomies of scale. We will pay special attention to the four technologically advanced industries out of 26 industries. The four high R&D-intensity industries in our sample are *other chemicals (incl. drugs)* (ISIC 352), *machinery nec (incl. computers)* (ISIC 382), *electrical machinery* (ISIC 383) and the *aircraft industry* (ISIC 3845).[17] These industries are assigned to have a dummy value $D_{r\&d}$ equal to one, while it is zero for the other 22 industries.

We will use a linear regression model to investigate the effect of restructuring and the extent to which this effect is industry-dependent. Previous research that has focused on the relation between scale of production (viz. small firm presence) and economic performance have either chosen to focus on the relation between economic growth and the level of small business presence (Carree and

Thurik, 1998; Robbins et al., 2000) or to focus on the relation between the *change* in the economic growth rate and the *change* in the level of small business presence (Audretsch et al., 2000). Our Equation (1) has the same independent variable as in this second approach.

$$VAI_{ijt} - \overline{VAI_{it}} = \alpha_j + \beta_i(DLES_{ij,\,t-1} - \overline{DLES}_{i,\,t-1}) + \delta(VAI_{ij,\,t-1} - \overline{VAI}_{i,\,t-1}) + \varepsilon_{ij} \quad (1)$$

In this equation the indices i and j stand for industry and country, respectively. The value added index (1990–1994), its lagged value (1986–1990) and the change in the large unit presence (1977–1990) are both taken in deviation from the industry mean across the three countries (for France, Germany and United Kingdom) and the two countries (for Japan and the United States) to remove industry-specific effects. This implies that the estimates for the parameters can be interpreted as fixed-effects estimates. We consider a constant country-specific effect (α_j) and an industry-specific effect of the relative restructuring rate (β_i). The constant country-specific effect is incorporated into the model to correct for economy-wide developments like changes in for example interest, tax and exchange rates. We distinguish between a general restructuring effect (β), a scale of production effect (γ_{sca}), a heterogeneity effect (γ_{het}) and an effect for industries with high R&D-intensity ($\gamma_{r\&d}$):

$$\beta_i = \beta + \gamma_{sca}\mu_i + \gamma_{het}\sigma_i + \gamma_{r\&d}D_{r\&d}. \quad (2)$$

The *scale* of production of industries is measured by the average μ_i of the large firm employment share for the countries in 1977. The extent to which industries are *heterogeneous* in terms of industrial structure is measured by the standard deviation σ_i of the large firm employment share across the countries in 1977. See the appendix for the value of these variables for the industries for the three European countries case and the case of Japan and the United States. In case the effect of the lagged dependent variable (δ) is equal to one, Equation (1) corresponds to the model used in Audretsch et al. (2000) in which the change in the economic growth rate is related to the (previous) change in small firm presence.

The general hypothesis is that industries that have employment shifting away from large firms in the period 1977–1990 have benefited in terms of economic growth in the early 1990s. However, the size of the effect is hypothesized to be industry-dependent. For example, in low-tech small-scale industries a shift away from large units may be counter-productive instead of beneficial to economic performance. We have three hypotheses concerning the industry-dependence of the effect:

H1: $\gamma_{sca} < 0$

H2: $\gamma_{het} > 0$

H3: $\gamma_{r\&d} \neq 0$

The first hypothesis is that industries with a relatively small scale of production do not benefit from a shift towards small units to the extent that industries with a large scale of production do.[18] The second hypothesis is that industries which have a large spread in the scale of production across countries benefit less from a change towards smaller units when compared with industries which have a very similar size class distribution across countries. The existence of strong differences in the size class distribution across countries indicates that the economic consequences of shifting structure in the particular industry may be relatively small. In addition to the two hypotheses we determine whether high-tech industries (with a high R&D-output ratio) differ from the other industries in benefiting from a shift towards (new and) small firms or in benefiting from remaining "large scaled".

The estimation results for Equation (1) for the three European countries with firm size data and for Japan and the United States with establishment size data can be found in Table IV. In the first and fourth column we show the results when neglecting industry-specific effects. The results show that only Japan and the United States have a significant country-specific constant. It implies that irrespective of the changes in industry structure Japanese industries have shown low growth while U.S. industries have shown high growth. Both for the firm data and establishment data we find a negative effect of DLES, but it is significantly different from zero only for the latter case. It indicates that, on average, a shift towards small units has led to increased growth.[19] The next columns of the table show that the extent of such an effect depends upon characteristics of the

TABLE VI
The effect of changes in *firm* and *plant* size distribution on value added growth (VAI)

Countries	France, Germany and U.K.			Japan and U.S.		
Units	Firms	Firms	Firms	Plants	Plants	Plants
α_{fra}	0.009 (0.6)	0.006 (0.4)	0.004 (0.2)			
α_{ger}	–0.012 (0.7)	–0.006 (0.3)	–0.007 (0.4)			
α_{uk}	0.004 (0.2)	–0.001 (0.0)	0.003 (0.2)			
α_{jap}				–0.048* (2.7)	–0.062* (3.8)	–0.061* (3.7)
α_{us}				0.048* (2.7)	0.062* (3.8)	0.061* (3.7)
β	–0.260 (1.5)	–0.149 (0.3)	–0.727* (2.3)	–1.068* (3.7)	–0.738 (0.8)	–1.824* (4.2)
γ_{sca}		–1.405* (1.8)			–1.772 (1.3)	
γ_{het}		9.877* (2.4)	8.403* (2.0)		10.527* (2.0)	13.805* (3.1)
$\gamma_{r\&d}$		–0.623 (1.5)	–0.736* (1.7)		–1.842* (2.5)	–1.831* (2.5)
δ	–0.027 (0.2)	–0.015 (0.1)	–0.021 (0.2)	–0.230* (1.9)	–0.272* (2.3)	–0.317* (2.8)
R^2	0.071	0.176	0.138	0.486	0.633	0.619
N	78	78	78	52	52	52

Note: Absolute *t*-values between brackets. A star (*) means significant at the 10%-significance level. *N* is the number of observations.

industry under investigation. In Table V we show estimation results when four small industries (in terms of employment), viz. *leather products* (ISIC 323), *footwear* (ISIC 324), *pottery*, *china*, *etc.* (ISIC 361) and *glass products* (ISIC 362), are left out to consider their impact on the estimation results. The results barely alter as a consequence of removing these small industries. We concentrate on Table IV when discussing the estimation results.

We find evidence for small scale industries to have benefited less from a shift towards smaller units ($\hat{\gamma}_{sca} < 0$). In addition we find R&D-intensive industries to benefit *more* from such a shift ($\hat{\gamma}_{r\&d} < 0$). However, the former effect is significant only in case of the firm data while the latter effect is significant only for the establishment data. Because R&D-intensive industries are among the ones having the largest scale of production it is possible that the two effects are (partially) overlapping. The results presented in the third and sixth column of the table show that this is barely the case, though the effect for R&D-intensive industries becomes significant at the 10% level for firm data when removing the scale effect. The data for the three European countries strongly suggest that high-tech industries may have benefited from a shift towards small units. That is, Germany experienced for each of the four high-tech industries the lowest value of VAI and the highest value of DLES for the three European countries.[20]

Industries in which the size class distribution differed strongly across countries in 1977 are found to have benefited less from a shift towards small units ($\hat{\gamma}_{het} > 0$). This appears in line with Simon's (1991) review on organizations and

TABLE V
The effect of changes in *firm* and *plant* size distribution, small industries removed

Countries	France, Germany and U.K.			Japan and U.S.		
Parameters	Firms	Firms	Firms	Plants	Plants	Plants
α_{fra}	0.003 (0.2)	0.002 (0.1)	–0.002 (0.1)			
α_{ger}	0.000 (0.0)	0.007 (0.4)	0.007 (0.4)			
α_{uk}	–0.003 (0.2)	–0.009 (0.5)	–0.005 (0.3)			
α_{jap}				–0.055* (2.9)	–0.062* (3.5)	–0.061* (3.5)
α_{us}				0.055* (2.9)	0.062* (3.5)	0.061* (3.5)
β	–0.246 (1.4)	–0.086 (0.2)	–0.605* (2.0)	–1.469* (4.6)	–0.534 (0.4)	–1.918* (4.2)
γ_{sca}		–1.242 (1.7)			–2.089 (1.2)	
γ_{het}		8.092* (2.0)	7.304* (1.8)		6.518 (1.1)	10.913* (2.2)
$\gamma_{r\&d}$		–0.699* (1.7)	–0.838* (2.1)		–1.629* (2.1)	–1.555* (2.0)
δ	0.038 (0.3)	0.050 (0.4)	0.047 (0.4)	–0.213* (1.8)	–0.244* (2.0)	–0.285* (2.5)
R^2	0.048	0.172	0.133	0.559	0.656	0.643
N	66	66	66	44	44	44

Note: Absolute *t*-values between brackets. A star (*) means significant at the 10%-significance level. *N* is the number of observations. Four "small" industries (ISIC 323, 324, 361 and 362) have been removed from the sample.

markets: "organization size and degree of integration, and the boundaries between organizations and markets, are determined by rather subtle forces. The wide range of organizational arrangements observable in the world suggests that the equilibrium between the two alternatives may often be almost neutral" (pp. 41–42). Indeed, when an industry used to have a wide range of organizational arrangements (size class structures) in the first "technological regime", differences in the rate of restructuring will tend not to matter that much. However, when this range was far more limited it is likely that important differences in the rate of restructuring affect economic progress in the subsequent "technological regime".

The effect of the shift in the size distribution is stronger for R&D-intensive industries ($\hat{\gamma}_{r\&d} < 0$). It suggests that an increase in the presence of small (innovative) firms has had an important impact on economic growth in the early 1990s. We provide two examples of industries to consider the total impact of the change in the size class distribution. For the R&D-intensive *electrical machinery* (ISIC 383) we find the total effect to be –1.498 for firm data ($\mu = 0.756$ and $\sigma = 0.034$) and –1.927 for establishment data ($\mu = 0.499$ and $\sigma = 0.146$). That is, a restructuring away from large units appears to have affected economic growth positively. For *furniture and fixtures* (ISIC 332) the total effect is 0.322 for firm data ($\mu = 0.185$ and $\sigma = 0.074$) and 0.742 for establishment data ($\mu = 0.139$ and $\sigma = 0.164$). In this case a shift away from large units has had no positive effects. This industry is a slow-growth small-scale industries. It may even be considered as favourable for a highly developed country in case

it gets a smaller share of the world market in such industries. It indicates structural adjustment from low-tech towards high-tech industries.

German manufacturing experienced a relatively slow and limited restructuring process when considering the limited change in the share of large firms in employment. This lack of restructuring may not have affected economic growth in small scale low-tech industries adversely, but it appears to have had a negative effect on growth in more large scale and high-tech industries.[21] Lehrer (2000) reports that German technology-based entrepreneurship picked up only in the late 1990s. The *Neuer Markt* for high-tech issues was important in this respect. Economic growth in the Japanese manufacturing sector was also below average during the early 1990s but the results indicate that this is not caused by lack of downsizing. Probably, this is a consequence of the average size of Japanese plants to have already been relatively low in the 1970s (Van Ark and Pilat, 1993, p. 35). Table II shows that the restructuring rate in Japan is about equal to the average. Therefore the lack of growth is mainly explained by the constant country-specific effect (economy-wide stagnation). However, Japanese industries, in which the rate of restructuring was particularly low compared to their American counterparts, appear to have suffered an additionally negative effect next to the economy-wide recession in Japan in the early 1990s.

4. Conclusion

One important dimension of structural change in industrialised countries has been the shift in economic actvitiy away from large units towards smaller counterparts (downsizing). This restructuring process has been taking place in the majority of manufacturing industries. However, the speed of this process has been different across countries and industries. In this paper we seek to estimate the effect of lagging behind in the downsizing dimension of the restructuring process. The statistical results provide empirical evidence for industrial restructuring to have affected value added growth. The results are especially strong for R&D-intensive industries and for industries which have not been very heterogeneous in terms of their industry structures.

We find evidence that industries that failed to restructure performed less well when compared internationally. Because (West) Germany has been restructuring relatively slow in the period before, this may provide one reason for the low pace of economic growth in Germany in the early 1990s next to the problems created by the reunification. However, the result does not explain the relatively low economic growth in the Japanese manufacturing sector as a whole when compared to U.S. manufacturing. The reason being that the extent of restructuring in these two countries in terms of the change of the large "establishment" share in employment was, on average, about equal. Both in the cases of Germany and Japan the results have to be interpreted with care as the economic performance of the two countries has been relatively weak in the period of the early 1990s due to problems of economy-wide structural adjustment.

The current paper concentrates upon one dimension of industrial restructuring, viz. downsizing. A further limitation to the current study is that only one measure of downsizing is considered. Our measure of the restructuring rate leaves some important questions open. A decrease in the large unit employment share may be the consequence of various factors like spin-offs (MBOs), closing down production plants, introduction of labour-saving technologies, new entrants or reforming the managerial hierarchies. Further research may provide more insight into the importance of these various factors in achieving economic growth.

Acknowledgements

The author is grateful for financial support by the Royal Netherlands Academy of Arts and Sciences (KNAW) and to David Audretsch for providing comments on an earlier version. The referee comments have helped improve this paper. An earlier version of this paper has been presented at the 27th annual EARIE-conference in Lausanne, Switzerland, 2000 and at the School of Public and Environmental Affairs, Indiana University, October 2000.

Appendix

TABLE A.1
Summary statistics for the share of firms or plants with 500 or more employees

ISIC	France, Germany and U.K. (firms)				Japan and U.S. (plants)			
	Share in 1977		Share in 1990		Share in 1977		Share in 1990	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
311/2	0.427	0.145	0.396	0.152	*0.161*	0.137	*0.187*	0.176
313	0.494	0.155	0.435	0.174	0.184	0.180	0.137	0.109
321	0.424	0.005	0.302	0.089	0.280	0.234	0.219	0.259
322	0.224	0.044	0.204	0.120	0.082	0.097	0.080	0.107
323	0.087	0.044	0.076	0.045	0.082	0.105	0.047	0.065
324	0.435	0.032	0.398	0.089	0.170	0.037	0.099	0.113
331	0.125	0.024	0.093	0.039	0.055	0.039	0.033	0.038
332	0.185	0.074	0.160	0.099	0.139	0.164	0.124	0.141
341	0.387	0.038	0.315	0.058	0.254	0.122	0.216	0.141
342	0.257	0.084	0.185	0.061	0.212	0.092	0.181	0.094
351	0.767	0.075	0.670	0.126	0.627	0.025	0.480	0.073
352	*0.638*	0.117	*0.660*	0.114	0.323	0.016	0.314	0.081
353	0.838	0.048	0.819	0.031	0.673	0.013	0.506	0.163
355	0.775	0.074	0.706	0.158	0.495	0.182	0.347	0.112
356	0.249	0.040	0.230	0.093	*0.072*	0.102	*0.083*	0.045
361	0.632	0.053	0.568	0.114	0.270	0.149	0.211	0.100
362	0.683	0.103	0.617	0.043	0.495	0.170	0.382	0.096
369	0.317	0.011	0.282	0.091	0.081	0.037	0.050	0.041
371	0.808	0.084	0.699	0.104	0.644	0.121	0.521	0.100
372	0.611	0.071	0.426	0.112	0.418	0.046	0.307	0.009
381	0.301	0.059	0.207	0.107	0.156	0.138	0.115	0.083
382	0.473	0.121	0.355	0.153	0.362	0.134	0.286	0.101
383	0.756	0.034	0.626	0.106	0.499	0.146	0.427	0.086
3843	0.888	0.043	0.818	0.112	0.669	0.143	0.624	0.102
3845	0.925	0.027	0.896	0.036	0.876	0.006	0.820	0.053
385	0.433	0.068	0.324	0.091	0.418	0.180	0.442	0.226
France	0.493		0.415					
Germany	0.512		0.492					
UK	0.511		0.416					
Japan					0.264		0.205	
US					0.405		0.352	

Note: The first two columns and the fifth and sixth column represent the values of μ and σ for the industries as used in Equation (2). Figures in italic mean that the average share of large units has increased over the 1977–1990 period. The bottom part of the table shows the averages across industries for the five countries. For Japanese industries the period is in fact 1975–1990 and for U.S. industries the period is in fact 1977–1987. Calculations based upon data presented in van Ark and Monnikhof (1996).

Notes

[1] Jensen (1993) uses the term Third Industrial Revolution and argues that technological advances are "encouraging smaller, more efficient, entrepreneurial organising units that co-operate through technology" (p. 842).

[2] Schmitz (1989) and Peretto (1999) present endogenous growth models in which the number of firms play an important role. The model developed by Schmitz implies that the equilibrium fraction of entrepreneurs is below the social optimal level. This suggests that welfare gains may be achieved by promoting the small business sector. Peretto's model predicts a hump-shaped relation between the number of firms and the returns to investment and R&D. In his model a large number of firms has the advantage of increased "specialisation" but the disadvantage of enlarged "fragmentation".

[3] The first to discuss the role of small firms in the job generation process is Birch (1981). It should be taken into account that small firms also usually have a relatively high job *destruction* rate. Acs et al. (1997) provide a discussion of the importance of small and medium-sized firms in the innovation and diffusion process. However, see Tether (2000) who argues that the role of new and small firms as job generators and innovators should not be taken out of proportion.

[4] Jovanovic (1993) claims that advances in information technology have made market-based co-ordination less expensive relative to internal co-ordination, partially causing the decline in diversification and firm size. Although corporate restructuring (downsizing) has been advocated as an instrument to achieve operating performance improvement of large firms, its effects on productivity are under debate (Bailey et al., 1996).

[5] Taplin and Winterton (1995) provide a nice illustration for the clothing industry.

[6] Loveman and Sengenberger (1991) present evidence for the share of *establishments* with 500 or more employees in the United Kingdom to have decreased strongly as well (see their Table IV B).

[7] The limited extent of downsizing in Germany might have been caused by firms having been slow in adopting new labour-saving technologies instead of being sluggish in reorganizing industry structure. However, this is not confirmed by investment data. Gross fixed capital formation as a percentage of value added in the German manufacturing sector was 12% on average for the 1977–1990 period (computed using data from OECD STAN Database, 1997). For the United Kingdom and the United States this percentage was equal to 12% on average, as well. The average percentage for this period for France was somewhat higher at 14%, and for Japan it was much higher at 19%. In each of the last five years of the period (1986–1990) the gross fixed capital formation percentage for German manufacturing exceeded that for U.K. and U.S.

[8] Klodt (1990) discusses how West German industrial policy in the 1970s and 1980s has repressed structural change with industries like mining, basic metals and shipbuilding receiving subsidies to prevent declining employment. See also Stamer (1998) for an econometric analysis relating subsidies, structural change and economic growth. Audretsch (2000) argues that important barriers to innovative activity have prevented Germany from generating a vibrant sector of new firms and new industries. See also Lehrer (2000) discussing the history of failure by the German economy to establish itself in new industries. Restructuring in the German economy started on a limited scale during the years 1994–1995 and has been claimed to have contributed to the economic recovery in the late 1990s (*The Economist* **343**, 5 April 1997).

[9] There are also papers that do not use industry-level data but study the impact of (developments of) the *economy-wide* share of small firms at the regional level. Audretsch et al. (2000) find evidence for a data set of 17 European countries for the period 1990–1994 that those countries that have been slow in shifting from "large" to "small" firms at the economy-wide level to have suffered in terms of GNP growth. The analysis leaves open the question, however, to what extent this is caused by sectoral (inter-industry) employment shifts or by intra-industry size class developments. Robbins et al. (2000) perform a panel analysis of 48 U.S. states for the 1986–1995 period and find that states with higher proportions of (very) small business employment (businesses with 20 employees or less) experience higher levels of productivity growth and Gross State Product growth.

[10] For Japanese industries the period is 1975–1990 and for U.S. industries the period is 1977–1987.

[11] Only one industry shows an increase in the average share over the 1977–1990 period: *other chemicals* (ISIC 352). The pharmaceutical industry is an important part of this three-digit industry.

[12] See Fagerberg (2000) for a study into the consequences of shifts in the economic structure on productivity growth. He finds evidence of an increase in the share of the electrical machinery industry (ISIC 383) in total manufacturing to have a positive and significant effect on the growth of total manufacturing productivity in the same period.

[13] Van Ark and Monnikhof (1996) report that especially for France and Germany it is difficult to distinguish handicraft from manufacturing. Therefore, we investigated the consequences of using LFES in terms of the share of firms with 500 or more employees in the total employment of firms *with 20 or more employees*. If we consider this share, the average LFES for France, Germany and the United Kingdom in 1977 were 0.533, 0.529 and 0.538, respectively. In 1990 these figures were 0.463, 0.512 and 0.444. It was found that measuring LFES in either of the two ways gives very similar results to the ones reported in Section 3.

[14] Some large multinational enterprises (like ABB) may be best described as a federation of companies with a global coordination center. The extent to which such companies are independent "observations" is sometimes unclear.

[15] Van Ark and Pilat (1993, p. 35) provide data comparing the median and average sizes of manufacturing *plants* for Germany, Japan and the United States (in 1987). They report a *median* plant size in the manufacturing sector of 318 employees for Germany, 166 for Japan and 263 for the United States. The *average* plant size is also the smallest in Japan at 16 employees. These average plant sizes are 30 for Germany and 49 for the United States.

[16] The development of the extent of scale and scope economies at the enterprise level and that at the establish-

ment level may differ over time. Gollop and Monahan (1991), for example, show for U.S. manufacturing over the 1963–1982 period, that enterprise diversification had been growing, while establishment diversification had been declining. Loveman and Sengenberger (1991), however, show in their Tables III and IV that downsizing of enterprises *and* establishments has been taking place in each of the five countries. Lane (1995, p. 73) also provides empirical evidence for France and the United Kingdom that the break-up of larger units into smaller ones took place both at the enterprise *and* establishment level. This strongly suggests that the industrial restructuring which started in the late 1970s may be described by the decline of the share of large units in terms of both "enterprises" and "establishments".

[17] This is according to Table 6 of Martins et al. (1996).

[18] Acs and Audretsch (1989) and Rosenbaum (1993) show that industries which have a high small firm presence are less attractive to new small entrants. A reason for this is that most market niches will already have been filled.

[19] The effect of DLES is –0.440 (t-value of 2.7) when combining the firm and establishment data of the five countries (to have 130 observations).

[20] Germany has a value of VAI (in deviation of the mean) of –0.08, –0.07, –0.09 and –0.07 for the four high-tech industries and a corresponding value of DLES (again in deviation of the mean) of 0.07, 0.07, 0.07 and 0.01.

[21] Carree et al. (2000) show evidence for Germany to have suffered in terms of economic growth as a consequence of having a (structurally) low rate of self-employment (at the economy-wide level). Reynolds et al. (1999) rank Germany as a country with a low level of entrepreneurial activity and claim that "Personal wealth creation or bankruptcy, though common consequences of entrepreneurship, are both regarded negatively among the German people." (p. 37).

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